PULP AND PAPER MAKING FROM GRASS FIBRE

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Abstract-Non-wood fibre materials offer an opportunity to replace the use of wood fibre in the production of pulp and paper in countries with insufficient wood fibre. The aim of this study was to evaluate the paper derived from *Cymbopogen Caesius* grass for its potential use in the paper industry. The physical properties of handmade sheet were analysed. *Cymbopogen Caesius* grass paper has brightness 27.7%, burst index 6.2 kPm^2/g , porosity 1600-2000 ml/min, kappa no. 18.4, opacity 99% with tensile strength 31.4 Nm/g and tearing index 4.6 mNm m^2/g. These characteristics show the suitability of *Cymbopogen Caesius* grass for pulp and paper production.

***Keywords**: Cymbopogen Caesius* **grass, pulp, non-wood fibre, burst index**

Introduction

Today, demand for paper and cardboard is increasing drasatically, and demand for raw materials is not sufficient for this. The global demand for paper and paperboard is estimated to be 490 million tones by 2020, with an average annual growth rate of 2.8%. It is estimated that 2.5 million tonnes of new pulp production capacity are required annually [1]. The ability of manufacturing non-wood pulp grows faster than wood pulp [2]. Non- wood pulp capacity was estimated at 5% of total paper making capacity in 2004 [3]. It has been estimated that around 15 billion trees are cut down each year for different purposes [4]. The non-wood pulp has low lignin content and hence more modest than wood pulp processes [5, 6]. Non-wood fiber can be used in all grade paper, cardboard and fiber [2, 7]. However, compared to wood sources, non-wood fiber sources involve challenges with seasonal availability, handling, low-density and high silica content [8].

The word "paper" is derived from plant papyrus. Papyrus is a thick material produced from the pith of the Cyperus papyrus plant. This plant was used in ancient Egypt long before the paper making in China. Paper is said to be invented by Chinese Ts'ai Lun in AD 105 from macerated vegetable fiber [9]. In India; paper was invented independently in Buddhist times around 250 BC. Before the industrialization of paper production, recycled fibres of hemp and cotton (called rags) were common source for paper production [10, 11]. Rare Islamic papers were made from hemp or grass stems in Rajasthan (India) and colored with vegetable dyes.

Paper consumption in India is 1.4 kg per capitawhich is very low as compared to USA having 285 kg per capita. But the economy is booming. With increase in marketing, the Indian papers are now appreciated all over the World. Over the past five years, exports of handmade papers have grown from India to Amsterdam, Brussels, New York, Berlin, Sydney, Tel Aviv and Tokyo. This is the time to search the raw materials for development of handmade paper technology in India. Thus Indian hand-paper making has great potential.

Grass as raw material for paper making

Countries that rely on agriculture, such as India and China, often provide agricultural raw materials. In order to effectively solve the problem of the supply of raw materials, one of the important steps taken by paper industries in these countries is non-traditional raw materials such as bagasse, straw, grass, waste paper, etc. for paper and paperboard making. Recently, grass as raw materials have been the focus of the scientific community to produce pulp and paper [12]. However, cultivation of grassland for pulp and paper industry has a strong competition because many grasses are used to obtain essential oils.

In pulp making from grass, the whole plant is used. At the pulp mills, dust and dirt from leaves is removed. Due to low lignin content, grasses are easier and quickly pulped. For example; in the sulphate process, only 10 minutes of cooking is done compared to 90 minutes of solid wood materials. In sulphate process, for instance, only 10 minutes of cooking is needed as compared to 90 minutes for hardwood material. This biomass contains inorganic minerals, which are essential and useful for plant growth. But these mineral also have a negative effect on the pulping and combustion processes, so their quantities used should be as low as possible. Silicon (Si), potassium, manganese, copper and iron are harmful for the pulping process [13].

Materials and methods

Raw Material

Cymbopogen Caesius used in this study was collected from regions of Sonepat, Haryana, India. The freshly cut *Cymbopogen Caesius* was chopped into small pieces upto 5 cm length. Then the pieces were dried in sun to remove moisture.

Fig 1. *Cymbopogen Caesius* Before chopping.

Pulping

80 gm of chopped pieces were dissolved in cooking liquor containing 10% of NaOH solution. The sample was cooked at 80°C for at least 4 hours. After cooling of the cooked samples, washing was done to remove lignin and minerals. The washed fibres are then grinded for 2-3 mins followed by screening process to remove large fibres.

Evaluation of handmade paper sheet

After pulping process, the paper sheet were made using hand vat. The properties of paper sheets such as tensile strength (TAPPI T494 om-96), tear index (TAPPI T414 om-98), burst index (TAPPI T403 om-97), kappa number (TAPPI T236 om-06) and brightness (ISO 2471), porosity, opacity were analysed.

Results and Discussion

The physical properties of handmade paper from grass are summarized in table 1. It can be observed that brightness of grass paper is 82.7%. Higher the value of brightness indicates the quality of paper. The burst index for paper sheet from beaten pulps ranges from 500-1000 PFI revolutions are in normal range for most paper uses such as for news print it is 0.65 kN/g and for rag paper it is 2.29 kN/g [14]. The burst index for grass paper is 0.60 kN/g which implies that this paper can be used for news printing. The burst strength represents the resistivity of paper of being ruptured when pressure is applied on it. The higher burst index produces due to higher bonding between the fibres present in paper [15].

Table 1: Properties of hand sheet made from grass

S.No.	Properties	Values
1	Brightness	27.7 %
2	Burst Index	6.2 kPm^2/g
3	Porosity	1600-2000 ml/min
4	Opacity	99%
5	Kappa number	18.4
6	Tensile Strength	31,4 Nm/g
7	Tearing index	4.6 mNm^2/g

The porosity of grass paper is 1600-2000 ml/min which is very high. Porosity contributes significantly to the opacity and light weight of paper. The opacity value is 99 % which is very high as compared to ISO scale. The paper making process determines the optical properties of that paper [16]. The value of kappa no. is 18.4 which show a better result and good quality of paper. Lowest kappa no. shows that the pulp has low lignin content. The tensile strength value (31.4 Nm/g) is lower than hardwood and other raw materials used for paper making. Tensile strength is directly related to the durability of various papers [17]. The tearing index has a high value of 4.6 mNm^2 /g. the tear index represents the magnitude of tearing force to which paper is subjected. It also depends upon the fibre length and their bondings strength [18].

Conclusions

Feasibility of pulp and paper production from *Cymbopogen Caesius* grass has been investigated in this study. The grasses could be pulped easily and quickly. The properties of grass paper were tested and found close to those of agricultural crops that are identified earlier. Thus it indicates that pulp from these grasses can replace hardwood pulp to a moderate extent. But there might be need to improve the drainage rates of the pulp to make them more acceptable to the paper industry. However *Cymbopogen Caesius* can become an effective source and products for pulp and paper industries.

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